



Extending bearing



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The port of Rotterdam in the Netherlands, the world's largest harbor, has an important logistics function for the German industrial region, the Ruhr. Products are transported from Rotterdam harbor by truck, train, airplane and cargo vessel. The least expensive mode of transportation, however, is by cargo vessel.

Specially-built cargo vessels and tankers navigate the Rijn (Rhine) River from Rotterdam to Germany and Switzerland and back to Rotterdam. One of these ships is the chemical tanker "Turbulentie," which is owned and commanded by Mr. Frans Jansen.

The Turbulentie was built in 1986 and modified in 1989. This modification turned the ship into the most modern chemical tanker of its day, in its class. It has five separate double wall stainless

steel tanks and can carry 1,778 tons (1.6 million kgs) of liquid. All operations involved in loading and unloading the ship are completely computerized. Even tank cleaning is computer controlled. No one has to enter the tanks for cleaning as everything is controlled from the bridge. The Turbulentie has a IIA classification, which allows Mr. Jansen to transport all types of chemical liquids.

Initially, Mr. Jansen was not pleased with the operation of his ship, which had cost \$2.1 million USD (4 million Dutch guilders) to build. On three separate occasions in 1988, the screw-shaft bearings showed excessive wear. The screw-shaft propels the ship and is, therefore, critical equipment. He seriously considered selling his ship.

However, after we analyzed his problem, he decided to use proximity probes, mounted 90° apart, on the screw-shaft bearings. We specially-designed a 4-channel gap monitoring device for his application and installed it. This device is battery-powered to elimi-

nate the need for hard-wiring. When the new probes were installed, the bearing surfaces were burnished and new oil seals also installed.

Bently Nevada XY proximity probes were installed on the two bearings of the screw-shaft (Figure 1). The probes are used to measure the screw-shaft average shaft position in the bearing. The custom-designed gap indicator makes it possible to observe changes in the dc gap voltages on all four channels. Changes in gap voltage indicate changes in the condition of the bearings.

Recommendations

Machine data was recorded using a Bently Nevada ADRE® 3 and 108 Data Acquisition Instrument. A Keyphasor® probe, observing a once-per-turn reference mark, provided machine speed and phase measurements. Figure 2 shows that, when the screw-shaft's speed increased from 121 to 280 rpm, the direct amplitude didn't greatly increase.

life on a chemical tanker's screw-shaft

Proximity probe installation eliminates the need for an annual screw-shaft bearing inspection

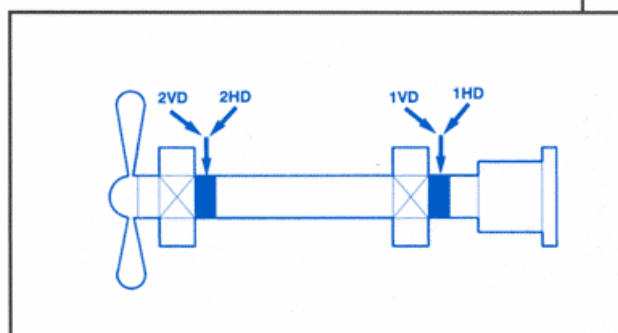
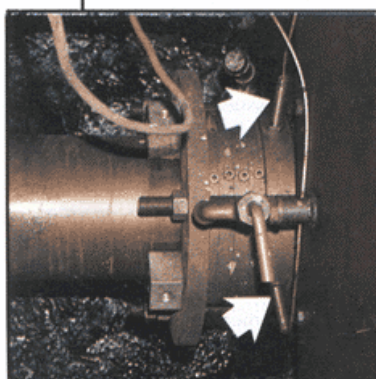


Figure 1
Screw-shaft showing
transducer locations



However, a speed increase from 280 rpm to 318 rpm resulted in a considerable increase of direct amplitude 2 mils ($55 \mu\text{m}$) peak-to-peak to 4 mils ($98 \mu\text{m}$) peak-to-peak). The screw-shaft's normal operating speed is 240 rpm. Based on this data, Bently Nevada advised Mr. Jansen that the screw-shaft's speed should not exceed 280 rpm (17.5 km/hour). The speed limitation, newly burnished surfaces and oil bath lubrication all helped to minimize bearing damage.

Once a month, Mr. Jansen logs the gap voltages into his data book. Although automatic Alert and Danger indication was available, Mr. Jansen preferred a gap only solution. He wanted to keep the system as simple as possible and to ensure that it would fulfill his needs.

Cost savings

This application of XY proximity probes eliminates the need for an annual screw-shaft bearing inspection. The cost for such an inspection is approximately \$5,320 USD (10,000 Dutch guilders), which doesn't include the loss of two day's production. Lloyds of London, the ship's insurance com-

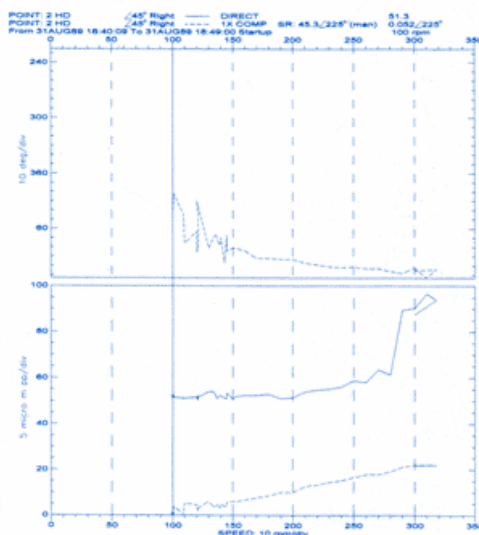


Figure 2

pany, requires that the ship operate with the highest level of safety. Lloyds requires bearing inspections to determine whether a foreign object has come into contact with the screw. Because the gap voltage readings from the proximity probes are sufficient to determine the screw-shaft bearing condition, Lloyds reduced the ship's insurance premium.

Conclusion

After being monitored for four years, the bearings are still in good condition. Mr. Jansen is very pleased with his monitoring system, which has saved him a considerable amount of money and time. To date, the ship has been running for 15,000 hours without any problems. ■